

# PERCEPTION OF NOISED WORDS BY NORMAL CHILDREN AND CHILDREN WITH SPEECH AND LANGUAGE IMPAIRMENTS

*V.V. Lublinskaja, I.V. Koroleva, A.N. Kornev, E.V. Iagounova*

I.P. Pavlov Institute of Physiology

199034, St.-Petersburg, nab. Makarova, 6 E-mail: chi@physiology.spb.su

Reserch Institute of Ear, Troat, Nose and Speech Pathology

198103, St.-Petersburg, Bronneckaya, 9 E-mail: vigarb@thewall.ioffe.rssi

## **Abstract**

The recognition of noised words by 4-7 years old children with normal speech (NS) and with speech and language impairments (SLI) was studied. It was shown that children in both groups have more mistakes and more long reaction time than adults. Moreover, SLI children had worse performance than NS. In both groups older ( $> 5$  years) children recognized noised words better than the younger ( $< 5$  years) ones. NS children perceived the words which were acquired at the early age with less mistakes than the words acquired at the older age. The relations between the development of speech perception, noise resistance and speech production are discussed.

## **1. Introduction**

In natural conditions man perceives speech in noised environments. Therefore the noise resistance is one of the most important qualities of speech perception. The ability to recognize speech in noise must develop during ontogenesis as the speech perception does. In spite of numerous studies of child speech perception only few of them consider the perception of noised speech [1,2]. The results of these experiments are contradictory. Perhaps it may be caused by the differences between used test procedures some of which were unsuitable for children. The traditional procedure of noised speech perception testing requires long time and the most difficult problem of such investigations is to keep child's attention during the session.

This work represents the study of noised words recognition by 4-7 years old children. The first task of our study was to elaborate the suitable test procedure for estimation of noised words recognition by the 4-7 years old children. The another tasks of our research were: 1) to investigate whether the noised words recognition changes from the age of 4 to 7 years and later; 2) to investigate the noised words performance in children with speech and language impairments; 3) to study the influence of linguistic competence on child's noised words perception; 4) to study the effect of speech production processes on noised words recognition.

## **2. method**

### **2.1. Subjects**

Three subject groups participated in the experiment: 1) 4-7 years old children with normal speech development (NS-group, N20); 2) 4-7 years old children with specific language and speech impairment (SLI-group, N21); 3) 30 adults. The children of NS-group attended kindergarten. The SLI group included children with developmental aphasia, dysarthria and developmental articulatory dyspraxia. All of them were patients of Child's Speech Rehabilitation Center. Only those who had normal hearing thresholds were included in the experimental groups.

### **2.2. Stimuli**

The test material consisted of 48 nouns from pre-school children vocabulary spoken by male

speaker (recorded in digital form). On conclusion of group of experts the words were divided in 2 parts: a) those which usually are acquired during first 3 years of life; b) the words are acquired at the age of 3 - 4 years and later. Most of them consisted of 2-3 syllables with different rhythmic structure. For this work the device developed on the base of the IBM PC was used. The device was provided with hardware and software advanced for working with speech signals ([4]). The noised words were made by the summation of the original words records with the white noise having the same duration (signal/noise amplitudes ratio was - 6 dB). The non-traditional method of noised words preparing was selected to reduce child's tiredness caused by the continuous noise.

### 2.3. Procedure

The stimuli were presented with two loudspeakers at comfortable loudness level. In the test procedure the noised and the "pure" words followed in random order, but for all words the "pure" stimulus preceded the noised one. Thus, the whole test consisted of 96 words: 48 noised words and 48 the same words without noise. This paradigm allowed to keep child's attention during whole test and to determine which words were familiar to a child. The task of subject was to point to the one of four pictures which corresponded to the presented word. Ten SLI-children participated in two sessions: in one session child had to repeat the word and to point to the picture, in another session the child only pointed to the picture. The order of two sessions was changed for different children. The computer device was used for words presentation and registration of child's reaction. The duration of test session was about 20 minutes. The training session preceded the test session.

### 3. Results

The comparison of the responses of NS, SLI and adults groups revealed that both groups of children recognized the noised words

significantly worse than the adults (Fig.1). SLI-children did it worse than normal ones (only the words which child recognized without noise were included in the analyses). The mean error rate in NS, SLI and adults groups were respectively 28%, 34% and 4%. Moreover, SLI-children had longer reaction time ( 1,67 s and 1,44 s correspondingly) and needed longer training session than NS-children. SLI-children also became tired sooner therefore they needed rest at the middle of session. The kind of clinical form and heaviness of speech disorder weren't significant for these differences. Mistakes were correlated in both groups.

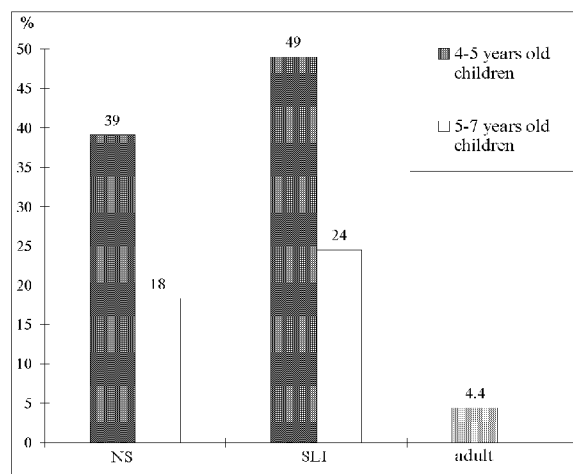


Fig.1. Percent uncorrect responses in adult, normal and SLI children.

NS - children with normal speech, SLI - children with speech and language impairments.

The influence of word repetition on recognition was absent: SLI-children had less mistakes at second session and it was independent from whether the child repeated the words or not.

For the noised words recognition the significant factor was the age of children: in both groups the younger children (4-5 years) made remarkably more errors than the older ones (5-7 years) (Fig.1). It was revealed also that aforementioned distinctions between NS and SLI-groups are the most prominent for the 4-5 years old subgroups.

It was found that NS-children have the best rate in recognition of noised words which usually

children acquire in early age (Fig.2). In SLI-group the effect of this factor was insignificant but one can see that the younger SLI-subgroup has higher difference in rates for "early" and "late" words than the older one.

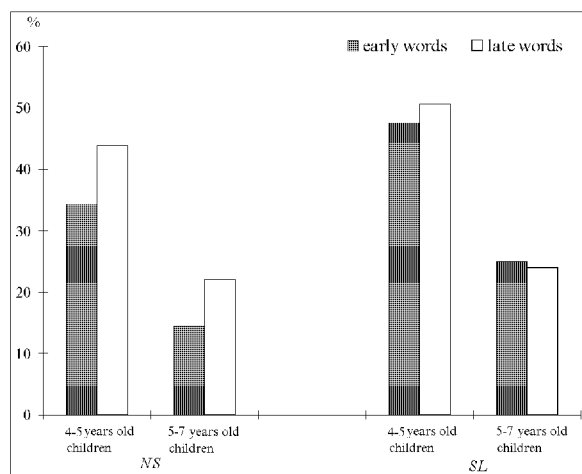


Fig.2. The age of acquisition influence of noised word recognition in normal and SLI-children.

The results also showed that in both groups of children the performance changed along the test session: at the first part of session the amount of mistakes gradually reduced, then it became stable ("plateau") and finally started to rise (Fig.3). Apparently, the first part of session corresponds to the period of child training and the final part is caused by fatigue. The central part ("plateau") had the longest duration and during this period the performance improved for NS-children, but it did not for SLI-children. Thus, on "plateau" the rate of recognition was better for NS-children.

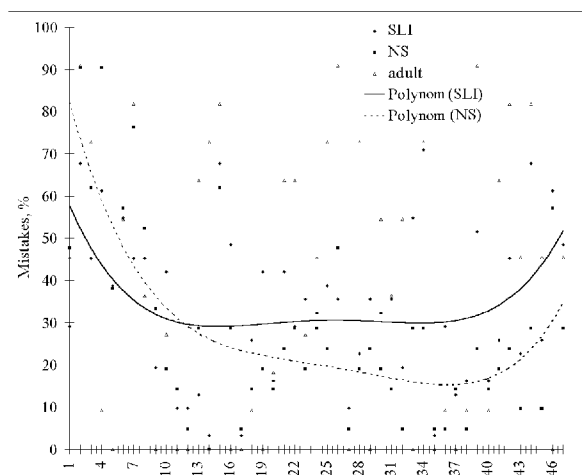


Fig.3. The mistakes distribution during session of noised word recognition.

#### 4. conclusion

A number of conclusions may be drawn from this data. The first is that the test procedure with equal duration of noise and words and with the alternative presentation of noised and "pure" words is suitable for study of the noised speech recognition at 4-7 years old children.

The second conclusion is that the ability of speech recognition in noised condition matures during 4-7 years of life and later. Apparently it relates to a few factors. One factor is the development of linguistic competence because it was revealed that NS-children better performed with the words acquired at earlier age than the words acquired latter. This effect was insignificant for SLI-children. On our mind it is caused by the fact that SLI-children have intense speech training at the Speech Rehabilitation Center. The training pays serious consideration to perception and generation of the words acquired later because children have more problems with them. Our assumption is supported by the fact that the younger SLI-children had more different rates for "early" and "late" words than the older SLI-children did.

The third conclusion is that the processes of speech production and speech generation does not make any remarkable influence on noised words recognition in children. It is concluded from the fact that the repetition of word and the kind of clinical form and heaviness of speech production disorder had no effect on SLI-children performance. The poorer noised words recognition by SLI-children may be caused by their having worse prelingual acoustic analyses and cognitive mechanisms. Our results (longer reaction time and training session duration, poorer rate at the central part -"plateau" of session at SLI-children) and data of other researchers [5,6,7] support this assumption.

## 5. eferences

- [1]. Elliot L.S., Connors S., Levin S., Ball K., Katz D. (1979) Children's understanding of monosyllabic nouns in quiet and in noise// J.Acoust.Soc.Am. V.66. P.12-21.
- [2]. Schwarz A.N.,Goldman R. (1974) Variables influencing performance on speech sound discrimination tests//J.Speech Hear.Res.. V.19. P.360-366.
- [3]. Shtern A.S. (1992) Perceptual problems of speech. St.Petersburg.115 P. (Øðåđí À.Ñ. Ĩăđöârîðèâíûâ aññiâèòû ðâ÷ââîé äâyðâëüĩñòè. 1992. Ñ.-Ĩăðâđáóðă.115 Ñ.)
- [4]. Knipschild M., Sappok Ch. (1991) Akustische Zeichenverarbeitung durch SONA und VERSTEU. "Fortschritte der Akustik-DAGA (Dad Honnef), , pp. 1045-1048.
- [5]. Elliott L., Hammer M. (1988) Longitudinal changes in auditory discrimination in normal children and children with language learning problems. J.Speech and Hear.Dis.,53,467-474
- [6]. Elliott L.,Hammer M.& Scholl M.(1989) Fine-grained auditory discrimination in normal children and children with language-learning problems. J. Speech a. Hear.Research, 32,112-119
- [7]. Ludlow C.,Cudahy E.,Bassick C.,Brown G.(1983) The auditory processing skills of hyperactive, language impaired and reading disabled boys. In J.Katz & E.Lasky (Eds.) Central auditory processing disorders: Problems of speech, language and learning. Baltimor.

*This work was supported by the Fond of Fundamental Research of Russian Academy of Science; grant N 96-06-80360.*